Jp06038415_circ_mag_rotor

# PATENT ABSTRACTS OF JAPAN


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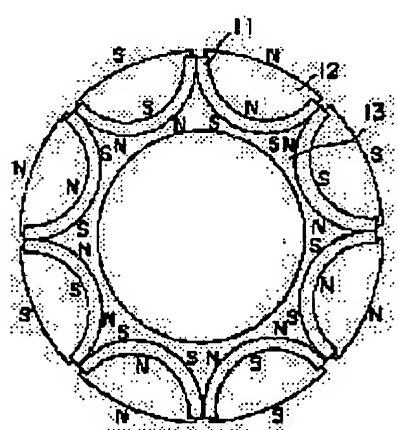
## (54) PERMANENT MAGNET TYPE ROTOR





(57)Abstract:

PURPOSE: To obtain a rotor structure which can generate a large amount of magnetic fluxes and is suitable for high-peripheral velocity operation by constituting a rotor base body of an inner cylinder section and outer cylinder section made of a soft magnetic metal and forming four or more magnetic poles by arranging magnetically integrated permanent magnets between the inner and outer cylinders.

CONSTITUTION: The inner cylinder section 13 of the rotor works to reduce magnetic reluctance between each permanent magnet 11. When about 80% or more of magnetic fluxes generated from the magnets 11 is supplied to the outer peripheral part of the rotor, the magnets 11 are magnetically integrated. The outer cylinder section 12 of the rotor is positioned on a straight line passing through the centroid of the magnets 11 from the center of the rotor on a cross section perpendicular to the rotating shaft of the rotor and mechanically restrains the magnets 11. While the magnets 11 have uniform radii of curvature on its inner and outer peripheries, the movement of the magnets 11 in the peripheral direction can be restrained when, for example, their larger and smaller radii of curvature are combined. In addition, when the thickness of the magnets 11 and the shortest distance between each magnetic pole are

larger, falling-off of the magnets 11 from the rotor can be prevented. In addition, when the number of the magnetic poles are increased to four or more, monopolar repulsion rotors can generate equal or more magnetic fluxes than external-magnet rotors.

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CLAIMS

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[Claim(s)]
[Claim 1] Permanent magnet type Rota which has the permanent magnet which has been arranged between the container liner section, the outer case section which consists of soft magnetism metals, this container liner section, and this outer case section, and which is one magnetically, and is characterized by the number of magnetic poles being four or more poles.
[Claim 2] The magnetic pole formed in the outer case section is permanent magnet type Rota according to claim 1 mechanically combined by the axis end although it separates into an adjoining magnetic pole and an adjoining magnetic target.
[Claim 3] Permanent magnet type Rota according to claim 1 or 2 where a permanent magnet makes $Nd_2Fe_{14}B$ a main configuration phase.
[Claim 4] Permanent magnet type Rota according to claim 1 to 3 where the outer case section exists on this straight line when the straight line which passes along a magnetic center of gravity from the Rota core on a cross section vertical to a revolving shaft is drawn.

[Claim 5] Permanent magnet type Rota according to claim 1 to 3 where the radius of curvature of said permanent magnet changes with locations in a cross section vertical to a revolving shaft.
[Claim 6] Permanent magnet type Rota according to claim 1 to 5 where the minimum distance between the magnetic poles of said outer case section is smaller than permanent magnet thickness.
[Claim 7] Permanent magnet type Rota according to claim 1 to 6 where the surface inductive flux around Rota magnetic pole 1 pole is larger than the flux density inside a permanent magnet.
[Claim 8] Permanent magnet type Rota [ longer than the die length of magnetic pole 1 pole / in / for the average die length of the pole face of the magnet on a cross section vertical to a revolving shaft / the Rota periphery ] according to claim 1 to 6.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to Rota for motors and Rota for generators which used the permanent magnet.
[0002]
[Description of the Prior Art] A brush loess DC servo motor and an AC servo motor are used in an extensive field with development of the rare earth permanent magnet ingredient of high energy products, such as Sm-Co and Nd-Fe-B, and generalization of the control approach using a semi-conductor. Development of an electric vehicle and an electric motorbike is activating in connection with a close-up of an environmental problem being taken again in recent years. It is thought that the synchronous motor which used the permanent magnet which can be miniaturized rather than an induction motor is suitable for the motor used for these propulsion applications. Rota of a synchronous motor has a demand having high flux density on the Rota front face, and that (2) permanent magnets cause neither demagnetization nor destruction by the heat cycle or high-speed revolution, in order to realize (1) miniaturization. Moreover, it is common to perform the generation of electrical energy called regenerative braking at the time of a slowdown by these motors for propulsion. Since an opposing magnetic field takes for a permanent magnet at this time, it is important that a permanent magnet does not demagnetize.
[0003] As Rota structure where it is used for the motor which used these permanent magnets, it roughly divides, and the following two kinds are known. One is a type (it is hereafter called periphery magnet Rota) which sticks a permanent magnet on the Rota periphery section of a soft magnetism metal with adhesives, and another is a type (it is hereafter called like-pole repulsion Rota) which arranges a permanent magnet in a radial from the interior of a rotor, and takes out magnetic flux in the Rota periphery section using like-pole repulsion. One example of periphery magnet Rota is shown in drawing 5 . In drawing 5 , 1 is a permanent magnet and the Rota base with which 2 consists of a soft magnetism metal, and a permanent magnet 1 is usually fixed to the peripheral face of the Rota base 2 with adhesives. Periphery magnet Rota is indicated by "Proceeding of 10 th internationalEV simposium, p214." One example of like-pole repulsion Rota is shown in

drawing 6 . In drawing 6 , 1 is a permanent magnet and the Rota base with which 2 consists of a soft magnetism metal. Like-pole repulsion Rota is indicated by JP,58-46859,A and JP,63-41307,B.

[0004]

[Problem(s) to be Solved by the Invention] There were the following troubles in conventional periphery magnet Rota. One is that a permanent magnet exfoliates from Rota and Rota under revolution breaks for a permanent magnet, the thermal stress produced according to the difference of the coefficient of thermal expansion of the Rota base, and the centrifugal force produced by high-speed revolution. To the conventional servo motor having been made several kW or less for small motors, since the output of 20-40kW is typically required, the motor for electric vehicles increases the diameter of Rota, and maximum engine speed. For this reason, the centrifugal force (it is proportional to the product of the diameter of Rota and a rotational frequency) in the Rota periphery section increases. Moreover, since the eddy current generated on the Rota front face by the alternating current magnetic flux of a stator increases so that a rotational frequency becomes large, the calorific value of Rota increases it. Compared with the case of the conventional servo motor, the possibility of the Rota destruction becomes high by the increment in this centrifugal force, and the increment in calorific value.

[0005] Generally [ in the case of an electric vehicle etc. ] Rota is [ a minimum of ]. -It is exposed to the temperature of 40 to a maximum of 100 degrees C or more. The coefficients of thermal expansion of the Nd-Fe-B system magnet used with the rare earth magnet and iron differ greatly, and the difference amounts also to 14 ppm. [ most ] If the distortion by **70 degrees C of temperature gradients becomes about **0.1% and it multiplies by 2 2x104 kgf/mm Young's modulus, the stress in an interface will serve as **2000 kgf/cm2. When the glue line of periphery magnet Rota is thin, a magnet will exfoliate without distortion being unabsorbable.

[0006] The centrifugal force by the revolution in periphery magnet Rota is calculated in a certain example. Nd-Fe-B and magnet thickness are set to 5mm, and a maximum engine speed is set [ a magnet Rota outer diameter ] to 10000rpm (167Hz) for 150mm and magnet construction material. When a permanent magnet is fixed by adhesion, the magnitude of a centrifugal force serves as 29 kgf/cm2. Although a permanent magnet does not destroy the tensile strength of a permanent magnet since it is about 800 kgf/cm2, the adhesion temperature of the adhesives in ordinary temperature is 200 kgf/cm2 at most, and it is difficult to guarantee long-term adhesion in the condition that temperature rose and bond strength fell. Since a rare earth magnet is an intermetallic compound, compared with the usual iron system structural material, destruction by tensile stress tends to produce it. For this reason, the example which fixes a rare earth magnet mechanically by the wedge presser-foot member is also proposed (JP,58-99252,A official report). However, it is difficult to eliminate thoroughly the danger of destruction of the permanent magnet resulting from the residual stress and the long-term thermal stress of a permanent magnet.

[0007] The torque coefficient (an output is proportional to the product of a torque coefficient, a current, and a rotational frequency) was decided mostly, and another problem had the problem of high-performance-being hard toize, when the diameter of Rota and the Rota die length of periphery magnet Rota were decided. Although a torque coefficient is proportional to the product of the amount of effective magnetic flux around

Rota 1 pole, and the number of magnetic poles, the increase of a pole, and in order that [ even if it carries out, ] the area around the part 1 pole may decrease and the effective flux density per pole may decrease, an increment in a torque coefficient can seldom be desired.

[0008] On the other hand, if like-pole repulsion Rota fixes the diameter of Rota, the Rota die length, and a permanent magnet configuration and makes the number of magnetic poles increase, in order that the amount of effective magnetic flux per pole may seldom decrease, a torque coefficient will increase it. Like-pole repulsion Rota has the description that high-performance-izing is possible, by multipolarization at this point.

[0009] However, conventional like-pole repulsion Rota had the following troubles. Since the permanent magnet is arranged at the radial, the magnetic flux which the short circuit of the magnetic flux in the Rota inner circumference section generates, and a permanent magnet generates does not concentrate on the Rota periphery section, but one is that magnetic-flux generating effectiveness is bad considering the permanent magnet volume. For this reason, there are seldom many examples of an activity of like-pole repulsion Rota.

[0010] Since magnetic-flux generating effectiveness of another was bad, it needed to make the bore small, and its moment of inertia of Rota was larger than periphery magnet Rota, and it had the problem that a controllability was bad. Moreover, the method which builds a magnet into the interior of a rotor is proposed by JP,2-44850,U. However, since the subcore arranged by this method at a magnetic inside-and-outside periphery is the same magnetic substance, there is a problem that a mechanical strength becomes weak and cannot bear a centrifugal force if the slot formed between each magnet for the short circuit of (2) magnetic flux short-circuited without a part of (1) magnetic flux coming out to the magnetic-substance exterior is enlarged.

[0011] In Rota for motors and Rota for generators which used the permanent magnet, the main object of this invention has the large amount of generating magnetic flux, and is to realize Rota structure suitable for a high peripheral-speed revolution.

[0012]

[Means for Solving the Problem] In order to solve the above-mentioned trouble, the following means were used in this invention. It is in having improved rather than conventional like-pole repulsion Rota about the amount of generating magnetic flux having embedded the permanent magnet to the interior of a rotor as the technical point, in order to resist a centrifugal force, and having held the permanent magnet mechanically with the soft magnetism metal, and by supplying the great portion of magnetic flux which a permanent magnet generates to the Rota periphery through a soft magnetism metal.

[0013] That is, said problem was solved by using permanent magnet type Rota whose number of magnetic poles which constituted the Rota base from the outer case section which consists of the container liner section and a soft magnetism metal, among these has arranged the permanent magnet which is one magnetically between a cylinder part and the outer case section is four or more poles.

[0014]

[Function] This invention is explained in full detail below. The outer case section which consists of soft magnetism metals first is explained. In this invention, this outer case section has achieved two kinds of duties, the work which holds a permanent magnet mechanically, and the work which lets efficiently the magnetic flux which a permanent

magnet generates pass to the rotor exterior.
[0015] The advantage to which the outer case section holds a permanent magnet mechanically is the cure against a centrifugal force and the cure against thermal expansion which were described previously. It has structure which embedded the permanent magnet in Rota by the method of this invention, and it is very reliable in order to respond to mechanically the centrifugal force generated at the time of the Rota revolution in the outer case section. This reason usually originates in having big fracture toughness with a soft magnetism metal, Young's modulus with a big iron system ingredient, and big elongation after fracture. If the part which arranges a permanent magnet, i.e., the space formed of the container liner section and the outer case section, is set up appropriately, destruction of the permanent magnet which considers thermal expansion as a cause can be prevented.
[0016] What is necessary is just to make it the outer case section located in the shape of [ this ] a straight line, when the straight line which passes along the center of gravity of a permanent magnet from the Rota core is drawn, in order to hold a permanent magnet mechanically. Moreover, a permanent magnet can be prevented from moving on a flat surface vertical to a revolving shaft by changing the radius of curvature of a permanent magnet by the location. Furthermore, the minimum distance between the magnetic poles of the soft magnetism metal of a periphery can also be made smaller than permanent magnet thickness so that a permanent magnet may not be omitted. In addition, between the magnetic poles of the outer case section, in order to raise magnetic effectiveness, having dissociated magnetically is desirable. Two or more of these three approaches may be combined.
[0017] The thing for which a permanent magnet is fixed to Rota at the time of a revolution and which fix Rota and a magnet using approaches, such as adhesives, a sealing compound, resin shaping, and metal dies casting, is [ like ] desirable. If these processings are performed at temperature higher than the operating temperature of a permanent magnet, the stress to which a permanent magnet remains after processing will turn into compressive stress, and it will be hard coming to destroy a permanent magnet.
[0018] As a method which forms the Rota base in the configuration which consists of a container liner and an outer case, it roughly divides and there are three kinds. One is the approach of carrying out the laminating of the thin soft magnetism metal (typically silicon steel) pierced with a press, and fixing to a rotor shaft. The 2nd is the approach of casting a soft magnetism metal and processing it if needed. The 3rd is the approach of sintering it by well-known approaches, such as a press or injection molding, after fabricating soft magnetism metal powder in a predetermined configuration, and performing a sizing press if needed. These approaches are suitably chosen by factors, such as a configuration, the magnetic properties of a soft magnetism metal demanded, and cost.
[0019] The 3rd approach can realize a certain amount of [ without processing ] precision, and it has the description [ gear ] that shaping is really possible, in container liner section inner circumference. It is possible to incorporate a reducer in Rota using this gear, and to heighten the output per mass of a motor, and industrial usefulness is large. This soft magnetism metal is attached in a revolving shaft by technique, such as a screw-thread stop known well conventionally, a rivet, and welding.
[0020] In this invention, magnetic-flux generating effectiveness was raised rather than

conventional like-pole repulsion Rota by considering as the Rota configuration by which the magnetic flux which the permanent magnet which is one magnetically generates is supplied to the Rota periphery side through a soft magnetism metal. What is necessary is for that, just to arrange a permanent magnet so that the leakage of the magnetic flux by the side of the Rota bore which conventional like-pole repulsion Rota had may be lessened. Here, two or more permanent magnets which the permanent magnet corresponding to the magnetic pole which appears in the Rota periphery that it is one magnetically in a cross section vertical to a revolving shaft is not divided, or were magnetized arrange with contact or a small clearance, as the same pole was located in a line, and a magnetic-circuit top says the condition that it can be regarded as the permanent magnet of one.

[0021] These examples are shown in drawing 1 and drawing 2 . In drawing 1 and 2, 11 and 21 are a permanent magnet, the outer case section by which 12 and 13 are constituted from a soft magnetism metal, respectively, and the container liner section. the container liner section 3 has come to be alike of the work which lessens magnetic reluctance between permanent magnets Drawing 1 is an example in case the permanent magnet is not divided. Drawing 2 is an example in one magnetically, although the permanent magnet is divided. As long as about 80% or more of the magnetic flux which a permanent magnet generates is supplied to the Rota periphery section, you may think that it is one magnetically. In drawing 1 , the outer case section 12 is located on the straight line which passes along a magnetic center of gravity from the Rota core on a cross section vertical to a revolving shaft, and restrains a permanent magnet 11 mechanically. Moreover, although the permanent magnet 11 of drawing 1 R> 1 has the uniform radius of curvature of an inside-and-outside periphery, if it is made to consist of combination of radius-of-curvature size and smallness, for example, the motion to a magnetic hoop direction can be restrained. Furthermore, if the thickness of the magnets 11 and 12 shown in drawing 1 and drawing 2 is [ the minimum distances 14 and 24 between magnetic poles ] size, a magnet can prevent dropping out out of Rota. The example perspective view of assembly of Rota by this invention is shown in drawing 7 . In drawing 7 , Rota 10 is mechanically combined by concluding with the bolt which does not illustrate the shaft member 15 which has a bolthole 16, although the magnetic pole which has the gestalt shown in drawing 1 and adjoins is separated magnetically.

[0022] The average surface inductive flux around Rota magnetic pole 1 pole is smaller than the average flux density inside a permanent magnet in periphery magnet Rota. On the other hand, it is possible to make average surface inductive flux around Rota magnetic pole 1 pole larger than the average flux density inside a permanent magnet in like-pole repulsion Rota or Rota of this invention. For example, it realizes by making the average die length of the pole face of the permanent magnet on a cross section vertical to a revolving shaft longer than the die length of magnetic pole 1 pole of the Rota periphery. Moreover, it is also possible to change the shape of surface type of the outer case section so that it may be indicated by JP,58-46859,A, and to adjust the flux density change by include-angle change.

[0023] Next, the permanent magnet and soft magnetism metal which are used for this invention are explained. In this invention, a rare earth permanent magnet means the permanent magnet which makes the intermetallic compound of rare earth elements, such as $SmCo_5$, $Sm_2Co_{17}$, $Sm_2Co_{17}N$, and $Nd_2Fe_{14}B$, and a ferromagnetic transition

element a main configuration phase. These permanent magnets can be manufactured by the approach of powder-metallurgy processing, plastic-working methods (setting rolling, extrusion, etc.), a bond magnet, etc. Its energy product is high, and especially when using the permanent magnet which makes the main phase Nd2Fe14B from which a soft magnetism metal and a coefficient of thermal expansion differ greatly, effectiveness of this invention is large. The soft magnetism metal in this invention means the ferromagnetic alloy which makes iron, nickel, cobalt, and them the main element excluding oxide ceramics like a ferrite. As a typical soft magnetism metal, pure iron, low-carbon steel, silicon steel, Permendur, etc. can be mentioned.

[0024] In this invention, the number of magnetic poles is made into four or more poles on the two poles, because the amount of magnetic flux is inferior to periphery magnet Rota. If it is four or more poles, like-pole repulsion Rota can generate the magnetic flux more than an EQC or an EQC rather than periphery magnet Rota. This reason is explained briefly. If the average flux density Bd inside the construction material of a permanent magnet and a magnet is the same and magnetic saturation does not happen, the amount phi of effective magnetic flux around Rota 1 pole becomes as follows (R and the Rota bore are set to r and Rota die length is set [ the number of the Rota magnetic poles ] to L for n (n is two or more even number) and the Rota outer diameter). In periphery magnet Rota, they are phi1=Bd and 2piRL/n mostly. (magnet thickness is disregarded)
In like-pole repulsion Rota, it is phi2=Bd, 2RL, and (R-r)/(R+r) (when the magnet has been arranged to the radial.) mostly. the leakage by the inner circumference of magnetic flux -- having taken into consideration -- it is expressed. It will be set to n> 4.25, if it sets with r=0.15R in a loan in consideration of the size of a revolving shaft and phi2>phi1 is solved. On the four poles (n= 4), like-pole repulsion Rota can generate the almost same magnetic flux as periphery Rota. If it is six or more poles, like-pole repulsion Rota can generate bigger magnetic flux, and it is desirable.

[0025]

[Example] An example explains one or less example and this invention. As a permanent magnet, the Nd-Fe-B system magnet of the shape of an arc of Br:11kG and iHc:26kOe was produced with powder-metallurgy processing. Orientation of the crystal grain has been carried out so that an easy axis may be in agreement radially. The periphery radius of an arc, an inner circumference radius, arc width of face, and arc length were 25mm, 20mm, 38mm, and 50mm, respectively, and after they removed the Sharp edge by barrel finishing, they performed nickel plating. It is an open beam near a periphery about 12 holes where cutting and a wire electron discharge method are performed to the soft magnetism metal (JIS S10C) which constitutes the Rota base with the outer diameter of 150mm, a bore [ of 100mm ], and a die length of 100mm (a revolving shaft is not included), and said magnet goes into it, and 24 screw holes of M8 for fixing to a revolving shaft. This Rota base has the configuration same with having been shown in drawing 1 . A total of 24 permanent magnets which applied the silicon system sealing compound to these holes was inserted.

[0026] The screw stop of said Rota base was carried out to the Rota revolving shaft made from stainless steel by M8, and Rota with 12 magnetic poles was manufactured. After attaching counter balance weight and taking the dynamic balance of this Rota, using the exclusive magnetization yoke, it incorporated in ordinary temperature and pulse magnetization (20kOe, 5ms) was performed. For a comparison, periphery magnet Rota (it

pastes up with the example 1 of a comparison and epoxy system adhesives) and like-pole repulsion Rota (example 2 of a comparison) which made the same magnet thickness and the diameter of the Rota inside and outside were manufactured, gap 1.0mm was separated, and the stator has been arranged. The Rota surface inductive flux and the flux density based on magnets were measured. A result is shown in a table 1.

[0027]

[A table 1]

| | 磁 束 密 度(kG) | |
|---|---|---|
| | ロータ表面 | 磁石中心 |
| 実施例1 | 11.7 | 8.7 |
| 比較例1 | 9.3 | 9.3 |
| 比較例2 | 9.6 | 7.0 |

[0028] The flux density on the front face of Rota is higher than other examples of a comparison, and it excels in the example of this invention. The example 1 of a comparison has the almost same flux density on the interior of a magnet, and the front face of Rota. Like-pole repulsion Rota of the example 2 of a comparison has the low flux density obtained, in order that magnetic flux may connect too hastily by the bore side. The result with good example 1 and example 1 of a comparison was shown.

[0029] Next, the spin test was performed at 80 degrees C. O It shall mean that abnormality nothing and x did not perform exfoliation from magnetic Rota, and - did not examine.

[0030]

[A table 2]

| | 回 転 数(Hz) | | | |
|---|---|---|---|---|
| | 50 | 100 | 150 | 200 |
| 実施例1 | ○ | ○ | ○ | ○ |
| 比較例1 | ○ | ○ | × | − |
| 比較例2 | ○ | ○ | ○ | ○ |

[0031] In periphery magnet Rota of the example 1 of a comparison, the magnet has exfoliated by high-speed revolution. Flux density of this invention is large and it turns out that it is the Rota structure where the dependability in a high-speed revolution is high. The dependability over a high-speed revolution is high like [ like-pole repulsion Rota ] this invention.

[0032] Examples 2-4 (magnet class)

Except changing magnet construction material, Rota of the shape of an example 1 and isomorphism was produced. SmCo5 and Sm2Co17 were produced with powder-metallurgy processing. Nd upsetting magnet was produced by setting the powder produced with the molten metal quenching method at 700 degrees C, and performing lump processing. At 25 degrees C, 150Hz performed the spin test. The example 3 of a comparison went in periphery magnet Rota of the shape of the example 1 of a comparison, and isomorphism.

[0033]

[A table 3]

| | 材質 | 熱膨張係数 | スピンテスト |
|---|---|---|---|
| 実施例2 | $SmCo_5$ | $13\times10^{-6}$ | ○ |
| 実施例3 | $Sm_2Co_{17}$ | $11\times10^{-6}$ | ○ |
| 実施例4 | Nd据込磁石 | $-1\times10^{-6}$ | ○ |
| 比較例3 | $Nd_2Fe_{14}B$ | $-1\times10^{-6}$ | ○ |

[0034] Every Rota is known by that it is equal to a spin test in ordinary temperature. Next, the thermal shock test of 100 cycles was performed between -40 degrees C and 180 degrees C. The spin test was again performed in ordinary temperature after that. A result is shown in a table 4.
[0035] As for the example 3 of a comparison, the magnet has exfoliated in the field where a rotational frequency is small. Since bond strength fell by the thermal shock test, it thinks. The magnet was not destroyed in the examples 2-4. The method of this invention happens and has exfoliation of a magnet and desirable destruction, when the difference of a soft magnetism metal and a coefficient of thermal expansion uses the magnet of large Nd system.
[0036]
[A table 4]

| | 回転数(Hz) 50 | 100 | 150 | 200 |
|---|---|---|---|---|
| 実施例2 | ○ | ○ | ○ | ○ |
| 実施例3 | ○ | ○ | ○ | ○ |
| 実施例4 | ○ | ○ | ○ | ○ |
| 比較例3 | ○ | × | − | − |

[0037] Examples 5-10 (difference by the number of magnetic poles)
The magnet which set 150mm and the Rota bore to 90mm, set Rota die length to 50mm, and was magnetized was inserted and pasted up for the Rota outer diameter on soft magnetism metal components, and Rota of the configuration which has the n times (2<=n<=9) symmetry of revolution shown in drawing 3 was manufactured. n becomes half [ of the number of magnetic poles ]. In addition, in drawing 3 , 31a and 31b are a permanent magnet, the outer case section by which 32 and 33 are constituted from a soft magnetism metal, respectively, and the container liner section. It inserted in the same stator as an example 1, and the Rota surface inductive flux was measured. A result is shown in a table 5.
[0038] The flux density on the front face of Rota increases, so that the number of magnetic poles is made to increase. Since the stator was saturated magnetically, the number of magnetic poles seldom changed to 16 poles on the 18 poles. Magnetic scattering did not take place by the spin test to 200Hz of Rota to examples 5-10.

[0039]
[A table 5]

| 実施例 | 磁極数 | 磁束密度(kG) |
|---|---|---|
| 5 | 4 | 8．0 |
| 6 | 6 | 9．5 |
| 7 | 8 | 11．0 |
| 8 | 12 | 12．0 |
| 9 | 16 | 13．2 |
| 10 | 18 | 13．6 |

[0040] Example 11 (difference by the magnet maintenance approach)
The magnetic cross-section configuration was changed and 8 pole Rota shown in drawing 4 was manufactured. In drawing 4 , 41 is a cross-section [ of L characters ]-like permanent magnet, the outer case section by which 42 and 43 are constituted from a soft magnetism metal, and the container liner section. Magnetic scattering did not take place by the spin test to 200Hz of Rota.
[0041]
[Effect of the Invention] The Rota structure where surface inductive flux is high and the dependability which is equal to a high revolution is high is realizable with this invention.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the example of invention in case the magnet is not divided.
[Drawing 2] Although the magnet is divided, it is drawing showing the example of invention in one magnetically.
[Drawing 3] It is drawing showing the example of invention (drawing displays 1/n of Rota) of Rota which has the symmetry of revolution n times (2<=n<=9).
[Drawing 4] A magnetic **** radius is drawing showing the example of invention which changes with locations.
[Drawing 5] It is drawing showing conventional periphery magnet Rota.
[Drawing 6] It is drawing showing conventional like-pole repulsion Rota.
[Drawing 7] It is the perspective view showing the example of assembly of this invention Rota.
[Description of Notations]
1, 11, 21, 31a, 31b, 41 Permanent magnet
2 Rota Base
12, 22, 32, 42 Outer case section
13, 23, 33, 43 Container liner section